Global Tropospheric Experiment Pacific Exploratory Mission-West B (GTE PEM West B) Langley ASDC Data Set Document

Summary

This document provides information on data products obtained during the GTE Pacific Exploratory Mission-West B atmospheric science expedition conducted over the western Pacific during February and March 1994. The objective of the mission was to investigate the atmospheric chemistry of ozone and its precursors and to examine the natural budgets of these species and the impact of anthropogenic sources. Measurements were made primarily by investigators' instruments located on the NASA Ames Research Center DC-8 airborne laboratory. Also provided are a list of principal investigators, a brief summary of measurement techniques and a list of publications.

This document provides information for the following PEM West B data sets:

gte_pemwb_dc8_msn_XX.zip:	DC-8 Aircraft Data for flight XX
gte_pemwa_jpg_msn_XX.zip:	Time series and altitude plots of *in situ* measurements on DC-8 flight XX
gte_pemwb_ground_ak.zip:	Measurements of Acidic Compounds, Particle concentrations, Total nitrate PAN, PPN, HCl, HBr, HNO_3, SO_2, and NH_3, from ground site on Oki Island, Japan; Measurements of SO_2, NOx, O_3 from PECAMPOT aircraft; Measurements of vertical profiles of O_3 recorded at Mt. HAPPO, Japan, and Okinawa, Japan; Measurements of vertical profiles of O_3 and CO recorded from Oki Island;
gte_pemwb_ground_la.zip:	Measurements of CO and O_3 from ground station located at 22.2 N latitude by 114.3 E longitude
gte_pemwb_ground_li.zip:	Measurements of SO_2, CO, O_3, and meteorological parameters from ground site at Kenting, Taiwan 21.9N, 121.86E); Rawinsonde sounding from Taipei station (25.03N, 121.5E), Hualien station (23.98N, 121.E), Ma-gong station (23.31N, 117.34E), Lyu-Dao station (22.28N, 120.28E), and Dong-Gang station (22.41N, 121.3E)
gte_pemwb_ground_pr.zip:	High volume samples of bulk aerosols for analysis of major ions and trace elements collected from ground sites at Cheju Island, Korea, Hong Kong, Okinawa Japan, Lin'An, China, Midway Island, Oahu, Hawaii, Shemya, Alaska, and Ken-Ting, Taiwan,
gte_pemwb_ground_ro.zip:	Aerosol nitrate and sulfate, HNO_3, NO SO_2, NOx, O_3, andd HC's from ground site at Lin'An, China
gte_pemwb_ground_zh.zip:	Measurements of SO_2, NO, NOx, O_3,
gte_pemwb_satellite_mmdd.zip:	Full disk satellite image for month mm, and day dd
gte_pemwb_lightning.zip:	DMSP Monthly Total Lightning Flashes for February and March
gte_pemwb_ozone_sonde.zip:	Ozonesonde launches from Hong Kong

Acknowledgment

NASA funded the investigators involved in the PEM West B mission. The funded investigators, their organization and their grant, agreement or contract number were:

Area	Investigator	Organization	Grant
Aircraft	A. Bandy	Drexel U	NAG-1-1224
	J. Bradshaw	Georgia Tech	NAG-2-954
	E. Browell	NASA Langley	N/A
	G. Gregory	NASA Langley	N/A
	B. Heikes	U of Rhode Island	N/A
	R. Pueschel	NASA Ames	N/A
	S. Rowland	U of California-Irvine	NAG-1-1553
	G. Sachse	NASA Langley	N/A
	H. Singh	NASA Ames	N/A
	R. Talbot	U of New Hampshire	N/A
Ground	R. Arimoto	U of Rhode Island	N/A
	J. Prospero	U of Miami	N/A
Modeling	D. Davis	Georgia Tech	N/A
	S. Liu	NOAA Boulder	N/A
	J. Merrill	U of Rhode Island	NAG-1-1235
	R. Newell	Mass Inst of Tech	N/A
	J. Rodriguez	AER	N/A

Table of contents

1. Collection Overview

a. Collection Contents

Aircraft data sets are available for each investigation for each flight. Airborne measurements were typically obtained at constant altitude over the North Pacific during transit flights (i.e. "survey" flights), and over multiple altitudes closer to Asia during flight from the intensive sites. Flight missions were conducted during PEM West B from February 7 through March 14, 1994. Hoell et al., [1997] lists the flight dates as well as the takeoff and landing times and site. Flight tracks and profiles are also shown in Hoell et al., [1997]. The duration, altitude range, ascent and descent rate, and flight path for each mission varied depending on mission objectives and environmental conditions. Further information about the measurement region and time frame may be found in the Journal of Geophysical Research, Vol. 102, No. D23, 28223-28239, December 20, 1997.

Data Set Introduction

This data set contains the DC-8 aircraft data submitted to the GTE data archive by the PEM West B investigators listed in Section 1.d. Included are the atmospheric chemistry, meteorological and navigational data recorded aboard the NASA DC-8 airborne. Additionally ground data, ozonesondes, rawinsondes, and satellite images are also included. Trajectories and merged data sets are not included in this archive. These data products can be found at the GTE data archive.

Summary of Parameters

The atmospheric species and other parameters measured are listed in Hoell et al., [1997]. Also listed for each are the name and affiliation of the principal investigator.

b. Related Data Collections

PEM West B investigators have individually reported the results of their investigations in the Journal of Geophysical Research, Vol. 102, No. D23, December 20, 1997.

There are data sets available from the Langley ASDC for 13 other GTE missions conducted from 1983 to 2001. See the GTE home page and/or the ASDC GTE Data and Information page for a description of the available data.

c. Title of Investigation

Global Tropospheric Experiment Pacific Exploratory Mission West B (PEM West B)

d. Investigator Name and Title

If the person is known to be retired, deceased or no longer at the organization, it is noted and the contact information may be omitted. The contact information provided was current during the mission, but may no longer be current.

DC-8 Measurements Investigators

Investigator Area	Investigator Information
DMS, SO_2, COS	Alan R. Bandy Drexel University Department of Chemistry 32nd and Chestnut Street Philadelphia PA 19104 Telephone: 215-895-2640 Fax: 215-895-1980 E-mail:bandyar@drexel.edu
Airborne Meteorological/Position Data	John D. Barrick MS 483 NASA Langley Research Center Hampton VA 23681-0001 Telephone: 757-864-5831 Fax: 757-864-5841 E-mail: john.d.barrick@nasa.gov
Investigator for Non-methane Hydrocarbons, Halocarbons, Terpenes	Don Blake University of California-Irvine Department of Chemistry Irvine, CA 92717 Telephone: 714-856-4195 Fax: 714-725-2905 E-mail: drblake@uci.edu
Investigator for Nitric Oxide, NO_Y	John Bradshaw (Principal Investigator, Deceased) Scott Sandholm (Co-Investigator) Georgia Institute of Technology Earth and Atmospheric Sciences Baker Building, Room 107 923 Dalney Street Atlanta GA 30332-0340 Telephone: 404-894-3895/3824 Fax: 404-894-5073

	E-mail: ss27@prism.gatech.edu
Investigator for Aerosols and Ozone Profiles	Edward V. Browell Mail Stop 401A NASA Langley Research Center Hampton VA 23681-0001 Telephone: 757-864-1273 Fax: 757-864-7790 E-mail: edward.v.browell@nasa.gov
In-situ Ozone, CO_2	Gerald L. Gregory (retired) NASA Langley Research Center
H_2O_2, CH_3OOH	Brian G. Heikes University of Rhode Island Graduate School of Oceanography South Ferry Road Narragansett RI 02882-1197 Telephone: 401-874-6810/6683 Fax: 401-874-6898 E-mail: bheikes@gso.uri.edu
Nitric Oxide, NO_Y	Yutaka Kondo Nagoya University Solar Terrestrial Environment Lab 3-13 Honohara Toyokawa Aichi 442 Japan Telephone: 81-5338-6-3154 Fax: 81-5338-6-0811 E-mail: kondo@stelab.nagoya-u.ac.jp
Aerosol size, quantity and composition	Rudi Pueschel NASA Ames Research Center Mail Stop 245-4 Bldg. 245, Room 142 Moffett Field CA 94035 Telephone:415-604-5254 Fax:415-604-3625 E-mail:rudolf_pueschel@mail.arc.nasa.gov
Carbon Monoxide, Methane, Nitrous Oxide	Glen W. Sachse MS 472 NASA Langley Research Center Hampton VA 23681-0001 Telephone: 757-864-1566 Fax: 757-864-8818 E-mail: glen.w.sachse@nasa.gov
PAN, PPN, C_2Cl_4, Ethanol	Hanwant Singh NASA Ames Research Center Mail Stop 245-5 Moffett Field CA 94035 Telephone: 415-604-6769 Fax: 415-604-3265 E-mail: hanwant.b.singh@nasa.gov
Aerosol Composition, Acidic Gases	Robert W. Talbot University of New Hampshire Institute of Earth, Oceans, Space Morse Hall Complex Systems Research Center Durham NH 03820 Telephone: 603-862-1546 Fax: 603-862-0188 E-mail: rwt@christa.unh.edu

e. Technical Contact(s)

The following persons have more specialized knowledge about the data in the data sets or in their field or general knowledge about the mission, its execution and the data sets.

Investigator or Knowledge Area	Investigator and Contact Information

OCS, SO_2, DMS	Donald C. Thornton Drexel University Department of Chemistry 32nd and Chestnut Street Philadelphia PA 19104	
PEM West B Mission Co-Scientists	Douglas D. Davis (See prior listing under Modelers above)	Shaw C. Liu (See prior listing under Modelers above)
PEM West B Program Manager	Robert J. McNeal (retired)	
PEM West B Project Manager	James M. Hoell, Jr. (retired) NASA Langley Research Center	
PEM West B Mission Meteorologist	Reginald Newell (deceased) Massachusetts Institute of Technology	
PEM West B Expedition Manager	Richard J. Bendura (retired) NASA Langley Research Center	
DC-8 Aircraft Manager	Leo DeGreef NASA Ames Research Center Mail Stop 211-12 Moffett Field, CA 94035 Telephone: 415-604-5342 Fax: 415-604-3885	Airborne Science Program Coordinator Office MS D1623H Edwards, CA 93523-0273 Phone: (661) 276-7453 Fax: (661) 276-3719
Logistics	Jacqueline Johnson (no longer at ST Systems) ST Systems Corp. 28 Research Drive Hampton VA 23666 Telephone: 757-865-7906 Fax: 757-865-0728	
Experiment Integration	Leo DeGreef (See prior listing under DC-8 Aircraft Manager above)	Joseph W. Drewry (retired)
PEM West B Data Manager	Joseph W. Drewry (retired)	
PEM West Steering Committee	• D. D. Davis (Co-Chairman) • S. C. Liu (Co-Chairman) • H. Akimoto • G. Chen Dept. of Atmospheric Sciences National Taiwan University Taipei, Taiwan Telephone: 886-2-363-1991 Fax: 886-2-363-3642 • R. E. Newell (deceased) • J. K. Park • J. M. Prospero • P. P. Sham Director, Royal Observatory 134a Nathan Road Hong Kong Telephone: 852-3732-9221 Fax: 852-3721-5034	• Hanwant B. Singh NASA Ames Research Center Mail Stop 245-5 Moffett Field CA 94035 Telephone: 415-604-6769 Fax: 415-604-3265 E-mail: hanwant.b.singh@nasa.gov • Y. Sugimura Head, Geochemical Laboratory Meteorological Research Institute Nagamine 1-1 Yatabe, Tsukuba Ibaraki305, Japan Telephone: 81-298-51-7111 Fax: 81-298-51-1449 • N. D. Sze • X. Zhou

2. APPLICATIONS AND DERIVATION

Potential usage and applications of the described data sets can be seen in the articles that comprise the Journal of Geophysical Research PEM West B Special Section (Vol. 102, No. D23, December 20, 1997).

a. Calculated Variables

For convenience of the users, the calculated variables below are provided.

Mach Number, M:

M = Mach Number

$$M = \sqrt{5 * \left[\left(\frac{Q_c}{P_s} + 1 \right)^{(2/7)} - 1 \right]}$$

Ps = Static Pressure
Qc = Differential Pressure

Static Air Temperature, Ts:

$$T_s(°K) = \frac{T_T}{\left[1 + M^2 * \left(\frac{\gamma - 1}{2} \right) \right]}$$

T_S = Static Air Temperature (°K)
T_T = Total Air Temperature (°K)
γ = 1.4, ratio of specific heat of air at constant pressure and volume

True Air Speed, TAS:

$$TAS(kts) = M * a = M * 38.96695 * \sqrt{T_s}$$

TAS = True Air Speed (knots)
T_S = Static Air Temperature (°K)
M = Mach Number
a = Speed of Sound

Potential Temperature, θ:

$$\theta(°K) = T_s * \left(\frac{1000}{P_s} \right)^{0.2857142}$$

θ = Potential Temperature (°K)
T_S = Static Air Temperature (°K)
Ps = Static Pressure (mb)

Vapor Pressure, e :

e_{water} (mb) = [1.0007 + (3.46 * 10^{-6} * P_S)] * 6.1121* EXP[17.502 * T/(240.97 + T)]

e_{ice} (mb) = [1.0003 + (4.18 * 10^{-6} * P_S)] * 6.1115* EXP[22.452 * T/(272.55 + T)]

e = Partial Pressure of Water Vapor (mb)
P_S = Static Pressure (mb)
T = Static Air Temperature (°C) for Saturation Vapor Pressure
or
T = Dew/Frost Point (°C) for Partial Pressure of Water Vapor

Note:

1. ProjDP of zero or greater should be used to derive the partial pressure of water vapor w.r.t water (e_{water}) and the ProjDP less than zero should be used to derive the partial pressure of water vapor w.r.t ice (e_{ice}).

2. StatTempDegC and ProjDP parameters recorded in the P-3B data set are substituted to calculate saturation vapor pressure and partial pressure of water vapor, respectively.

3. TSDEGC and ProjDP parameters recorded in the DC-8 data set are substituted to calculate saturation vapor pressure and partial pressure of water vapor, respectively. Also notice in the DC-8 data set there is a redundant static air temperature measurement, TSCALC, which is calculated by DADS. Although TSDEGC and TSCALC track closely they can diverge by ?1° at the low and high ends of the measurement range.

Specific Humidity, q:

$$q(g/kg) = \frac{0.622 * 10^3 * e}{(P_s - 0.377e)} \qquad q(ppmw) = \frac{0.622 * 10^6 * e}{(P_s - 0.377e)}$$

Mixing Ratio, r:

$$r(g/kg) = \frac{0.622 * 10^3 * e}{(P_s - e)} \qquad r(ppmw) = \frac{0.622 * 10^6 * e}{(P_s - e)}$$

Note:
ppmv = 1.608 * ppmw
ppmw = 0.622 * ppmv

Relative Humidity, %:

w.r.t. water,

$$RH_{water} = \frac{e_{water}}{e_{S_{water}}} * 100$$

w.r.t. ice,

$$RH_{ice} = \frac{e_{ice}}{e_{S_{ice}}} * 100$$

b. Graphs and Plots:

Interested readers should see the Journal of Geophysical Research, Vol.102, No. D23, December 20, 1997, and documents referenced therein, for plots and the results of analysis of data.

3. DATA DESCRIPTION AND ACCESS

a. Format

See the GTE Data Format Document.

b. Data Organization

Granularity

A general description of data granularity as it applies to the IMS appears in the EOSDIS Glossary. Aircraft data sets are available for each investigation for each flight.

c. Data Collection Status and Plans

This data set contains the DC-8 aircraft data submitted to the GTE data archive by the PEM West B investigators listed in Section 1.d. Included are the atmospheric chemistry, meteorological and navigational data recorded aboard the NASA DC-8 airborne laboratory and data obtained from surface level sites. Ground data, ozonesondes, rawinsondes, modeling products, satellite images, trajectories and merged data sets are not included in this archive. These data products can be found at the GTE data archive. No additional data products relevant to PEM West B are anticipated.

d. Data Access

This data is available online through the GTE Data and Information table or on a CDROM via the LaRC ASDC and from the GTE data archive.

e. Data Archive Center

The Atmospheric Science Data Center at NASA's Langley Research Center.

Contacts for Data Center or Data Access Information:

User and Data Services Group
Atmospheric Science Data Center
MS 157D
Langley Research Center
Hampton, VA 23681 USA
Phone: 757-864-8656
Fax: 757-864-8807
Email: support-asdc@earthdata.nasa.gov
Internet: http://eosweb.larc.nasa.gov

f. How to Cite the Data Collection

Publication of a portion(s) of the data archive should acknowledge the principal investigator(s) responsible for the data by referencing the appropriate manuscript in the Journal of Geophysical Research, Vol. 102, No. D23, December 20, 1997.

4. DATA CHARACTERISTICS

a. Study Area

Airborne measurements were made over the western Pacific. A more detailed description of the surface level environmental characteristics for the experiment region is provided in the individual papers for each investigation included in the Journal of Geophysical Research, Vol. 102, No. D23, December 20, 1997. Additional information may be found in other publications authored by the principal investigators or on the GTE homepage.

Spatial Coverage

Airborne measurements were made predominately over the western Pacific Ocean. A more detailed description of the surface level environmental characteristics for the experiment region is provided in the individual papers for each investigation included in the Journal of Geophysical Research Vol. 102, No. D23 December 20, 1997. The duration, altitude range, ascent and descent rate, and flight path of each mission varied depending on mission objective and environmental (weather) conditions. The nominal airspeed ranged from greater than 485 knots (approximately 560 mph) at 13 km altitude to 317 knots (approximately 365 mph) at 0.20 km.

Measurement Platform	Min Lat	Max Lat	Min Lon	Max Lon
DC-8 Aircraft	9.6S	60.9N	164.0E	173.2W

Spatial and Temporal Resolution

Resolution varies for each measurement. See Hoell et al, [1997].

Grid Description

No data gridding or binning of data to a geographic grid occurred during data processing.

b. Temporal Coverage

Sixteen aircraft missions were conducted from February 7 through March 14, 1994. Hoell et al, [1997] gives dates and times for each flight.

c. Parameter or Variable

Not all of the parameters are in each data set granule. Also, the ranges vary between data sets and between granules within each data set. Species measured are given in Hoell et al, [1997].

Parameter Description

The variables measured are standard atmospheric chemical and meteorological species requiring no further elaboration here.

Unit of Measurement

The units of measure vary widely depending on species and measurement environment and are addressed in the individual papers for each investigation included in the Journal of Geophysical Research, Vol. 102, No. D23, December 20, 1997.

Parameter Source

The instruments used in making the measurements are listed in Hoell et al, [1997].

Parameter Range

The ranges of data vary widely depending on species and measurement environment and are addressed in the individual papers for each

investigation included in the Journal of Geophysical Research, Vol. 102, No. D23, December 20, 1997.

Sample Data Record

The GTE Data Format Document contains examples of each data set type.

d. Error Sources:

The sources of error vary depending on species and measurement environment and are addressed in the papers included in the PEM West B special issue of the Journal of Geophysical Research, Vol. 102, No. D23, December 20, 1997, and/or papers referenced in that publication and readme files and/or header records associated with each data file.

5. USAGE GUIDANCE

a. **Known Problems with the Data**

None reported for the current archive version. See the readme files and header records included with each data set for information provided by the responsible investigator.

b. **Future Modifications and Plans**

The data sets submitted to the ASDC are considered final and no further updates are anticipated. However, modifications will be considered if requested by the investigators or otherwise justified.

6. ACQUISITION MATERIALS AND METHODS

Details of data acquisition and materials are addressed the papers contained in the Journal of Geophysical Research PEM West B Special Section (Vol. 102, No. D23, December 20, 1997).

7. REFERENCES

GTE Bibliography

PEM West B Special Section, Journal for Geophysical Research, Vol. 102, No. D23, December 20, 1997.

Hoell, J. M., D. D. Davis, S. C. Liu, R. E. Newell, H. Akimoto, R. J. McNeal, and R. J. Bendura, The Pacific Exploratory Mission-West Phase B; February-March 1994, J. Geophys. Res., 102, 28223-28239, 20 December 1997.

8. ACRONYMS

AER - Atmospheric and Environmental Research
ASDC - Atmospheric Science Data Center
DADS - Data Acquisition and Display System
DFRC - Dryden Flight Research Center
EOSDIS - Earth Observing System Distributed Information System
GTE - Global Tropospheric Experiment
IMS - Information Management System
LaRC - Langley Research Center
NASA - National Aeronautical and Space Administration
NOAA - National Oceanographic and Atmospheric Administration
PEM - Pacific Exploratory Mission
ProjDP - Project Dew Point
TSCALC - Static temperature, calculated by DADS
TSDEGC - Static temperature, measured directly, in Celsius

9. Document Information

- **Creation Date:** November 2003
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